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(19) (CA) **CANADIAN PATENT** (12)

(54) Perimeter Seal for Disposable Respirators

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(30) (US) U.S.A. 911,729 1986/09/26

(57) 11 Claims

Canada

1296487**PERIMETER SEAL FOR DISPOSABLE RESPIRATORS****BACKGROUND OF INVENTION**

The present invention relates to a partial
5 perimeter face seal for molded disposable respirators
and/or filtration masks. The seal comprises a conformable,
pliant pad, non-permeable to low pressure air flow, bonded
about the peripheral edge of the respirator in the nose and
upper cheek areas and is in the form of a segment of the
10 circle defined by the base of the respirator, said segment
constituting no more than about 30% of the total area of
the circle. The nose and upper cheek areas are among the
most difficult areas to achieve a good fit or seal on half
mask disposable respirators. The almost infinite variety
15 of shapes and sizes of noses and upper cheek features makes
it difficult to design a single respirator which will
achieve the desired fit on every wearer.

Efficacious sealing is necessary to insure that
the respirator provides adequate protection to the wearer.
20 Proper face fit or sealing must be accompanied by user
perceived comfort to assure that the respirator is indeed
worn as intended rather than draped around the wearer's
neck or discarded because it was uncomfortable to wear.

To date, the more common approaches to achieve
25 improved face fit of disposable respirators have included
full perimeter sealing elements, molding additional
structure into the nose and upper cheek areas of the
respirator to improve conformance to facial features, the
use of a malleable metal strip on the exterior of the
30 respirator immediately above the nose to help conform the
respirator to facial contours and the use of an interior
strip of foam in the nose and upper cheek areas, often in
combination.

A 35 A commercially available molded dust and mist
respirator (3M^{*} 8710 respirator) incorporates a sealing

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element consisting of an exterior malleable metal strip in conjunction with a narrow open-cell foam strip adhesively bonded to the interior of the respirator in the nose and upper cheek areas. Face fit comparable to that obtained with full perimeter sealing elements can be achieved with this respirator by careful adjustment of the malleable metal strip to get the respirator body to properly conform to the nose and upper cheek facial features.

A commercially available paint spray respirator (3M 8709 respirator) utilizes full perimeter sealing elements in conjunction with an exterior malleable metal strip. The sealing elements consist of a full perimeter Kraton rubber gasket in combination with an open-cell foam pad adhesively bonded to the gasket in the nose and upper cheek areas. The gasket is bonded about the perimeter of the respirator. This full perimeter seal allows for good face fit of a rather bulky respirator.

U.S. Patent 4,319,567 relates to a molded face mask having nose pad portions consisting of fibers which are more lightly compacted than the fibers in the central portion of the mask and, being thicker and flexible, provide a seal against the nose and cheekbones of the wearer.

U.S. Patent 4,384,577 describes a disposable face mask having a shaped respirator body with a nose bridge portion and nose pad portions which, in conjunction with a tightly compacted elongated ridge extending across the bridge of the nose and along the nose pad portions, improve the seal between the mask and the wearer's face through the spring action of the ridge in maintaining the nose pad portions against the nose and cheeks.

U.S. Patent 4,454,881 relates to a filtration mask construction having a molded rubber-like bead member around the periphery of the mask to provide an edge seal between the face mask and the face of the wearer, the bead member including membrane portions extending to the interior of the mask inwardly from the bead member at least

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pad comprising a segment of the circle circumscribed by the base of the respirator body, said segment accounting for no more than about 30% of the total area of said circle, said pad being attached continuously along only its circular edge to the perimeter of said respirator body so that said edge of said pad forming said chord of said segment of said circle is free of attachment to said respirator body and is limply conformable into sealing contact with the nose and upper cheek area of the wearer.

BRIEF DESCRIPTION OF THE DRAWINGS

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Figure 1 is a rear perspective view of a molded

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disposable respirator with the partial perimeter face seal of the present invention;

Figure 2 is a plan view of the respirator and face seal of Figure 1; and

5 Figure 3 is a diagrammatic view of the respirator and face seal of Figure 2, after all molded structure and/or shaping of the respirator have been removed.

DETAILED DESCRIPTION OF THE INVENTION

10 Referring now to the drawings, the partial perimeter face seal 20 of the present invention is designed for use with a molded disposable respirator 10. As clearly shown in Figure 1, the body 11 of respirator 10 is molded to a generally cup-shaped configuration to fit over the
15 nose and mouth of the wearer. Respirator 10 is provided with elastic head bands 12 to hold the respirator against the user's face and also a malleable metal nose strip 13 to help conform the respirator to the facial contours of the wearer.

20 Partial perimeter face seal 20 comprises a conformable, pliant pad 21, non-permeable to low pressure air flow, bonded along line 22 about the peripheral edge 23 of respirator body 11 in the nose and upper cheek areas. Pad 21 is in the form of a segment S of the circle C
25 circumscribed by the base of the respirator 10, segment S constituting no more than about 30% of the total area of circle C. Segment S is further characterized as being the area defined by chord AB and the arc AB that it subtends on circle C. The angle θ , defined by the two radii AO and BO
30 of circle C which intersect the circumference at the points intersected by chord AB, is greater than 70° and less than 150°. Pads 21 so defined will account for a minimum of about 5% and a maximum of about 30% of the area of circle C. It has been empirically determined that pad 21 should
35 not comprise more than about 30% of the total area of the respirator 10 since above about 30% of coverage, filtration efficiency and pressure drop would be deleteriously

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affected. Similarly, below about 5% of coverage, pad 21 would not provide an effective seal.

It will be appreciated that pad 21 may take shapes (other than segment S) such as having a narrow section immediately above the nose area and wider portions in the upper cheek areas. Alternatively, small foam pads may be placed behind pad 21 in the nose area.

Pad 21 should, of course, be non-permeable to low pressure air flow. Closed cell foam materials are, therefore, particularly well suited for this purpose. Open cell foams can be rendered non-permeable to low pressure air flow by being bonded to a non-permeable compliant substrate or by forming a "skin" on at least one surface of the foam material. Such skins can be produced by passing the open cell foam material over a hot surface thus causing the surface material to flow and form a continuous skin. It is also possible to coat one surface of the open cell foam material with a thin layer of a film forming composition. Pad 21 can also be fabricated out of conformable and pliant elastomeric sheet materials. A particularly useful synthetic rubber-like material is available under the trade description Kraton from Shell Chemical Co. in thicknesses ranging from 0.003 to 0.032 inch.

The presently preferred materials for pad 21 are closed cell foams. Particularly preferred among the various closed cell foams are those which are ultrasonically weldable to the respirator body 11. One such foam is a 6 pounds per cubic foot polyvinyl chloride based closed cell foam available from Illbruck USA under the trade designation SV-206. Foams in thicknesses ranging from 1/16 to 1/4 inch have been found to function well from the processing as well as performance standpoints. The resiliency of such "soft" foams additionally contributes to user perceived comfort and encourages use of the respirator.

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As noted, pad 21 is advantageously bonded to respirator body 11 by ultrasonic welding. Other bonding techniques such as adhesive attachment or mechanical bonding methods such as sewing or stapling can also be utilized. Whichever bonding method is selected, it is important that a continuous bond or seal be formed so that no leakage occurs between the respirator body 11 and pad 21.

A respirator 10 incorporating the partial perimeter face seal 20 of the present invention was prepared by (1) layering a 20% surface coverage segment pad 21 of 1/8 inch thick, 6 lbs/ft³, closed cell polyvinyl chloride foam (SV-206), a preformed molded cup-shaped body component and a preformed cup-shaped filtration body comprised of an electrostatically charged polypropylene blown microfiber web and a lightweight cover web of polypropylene fibers, pad 21 being positioned in the nose and upper cheek area of the respirator as shown in Figure 2, and (2) bonding the three components together by means of an ultrasonic welding operation to form a continuous bond line 22 about the perimeter 23 of the respirator 10. Subsequent to the ultrasonic welding operation, malleable metal nose clip 13 was adhesively bonded to the exterior surface of respirator body 11 immediately above the nasal area of the respirator and elastic bands 12 were secured to the sides of the respirator by stapling.

Respirators 10, incorporating the partial perimeter face seal 20 of the present invention, were evaluated for face fit performance. Excellent results were achieved with fit factors equal to and exceeding those obtained with identical respirators having full perimeter face sealing elements.

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in the area of the sides of the nose and upper cheekbones of the wearer.

U.S. Patent 4,037,593 relates to a rectangular "gauze" surgical mask having a vapor barrier for preventing clouding or fogging of optical aids. The barrier comprises a contoured strip of soft closed-cell foam along the upper edge of the mask. A malleable metal strip assists in maintaining the barrier against the wearer's face.

10 U.S. Patent 3,757,777 relates to a half-mask respirator with a plastic collar which is contoured to the exact shape of the wearer's facial features. Immediately prior to wearing the mask, a thin layer of liquid catalytically or low temperature cured plastic is applied to the facial contact area of the collar or directly on the inner periphery of the mask. The plastic is cured while the mask is held in contact with the face, thereby forming an individually tailored face seal.

Reusable respirators utilize a variety of sealing element designs to achieve a seal between the mask and the user's face. These sealing elements generally are molded rubber members
20 having inward projecting flanges or flaps which conform to the contours of the user's face (see U.S. Patents 4,414,973, 4,167,185, 3,330,273 and 3,330,274).

SUMMARY OF THE INVENTION

The present invention provides a partial perimeter face seal for disposable respirators comprising a conformable, pliant pad which is non-permeable to low pressure air flow, said pad being continuously bonded to the periphery of the porous respirator filtration body in the nose and upper cheek area, said

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THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A partial perimeter face seal for disposable respirators comprising a conformable, pliant pad which is non-permeable to low pressure air flow, said pad being continuously bonded to the periphery of the porous respirator filtration body in the nose and upper cheek area, said pad comprising a segment of the circle circumscribed by the base of the respirator body, said segment accounting for no more than about 30% of the total area of said circle, said pad being attached continuously along only its circular edge to the perimeter of said respirator body so that said edge of said pad forming said chord of said segment of said circle is free of attachment to said respirator body and is limply conformable into sealing contact with the nose and upper cheek area of the wearer.

2. The face seal of claim 1 wherein said pad comprises a sheet of conformable, resilient, closed cell foam material.

3. The face seal of claim 1 wherein said pad comprises a sheet of a conformable, resilient, skinned open cell foam material.

4. The face seal of claim 1 wherein said pad comprises a sheet of an elastomeric film.

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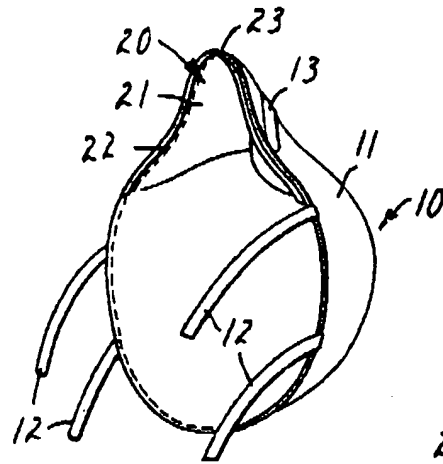
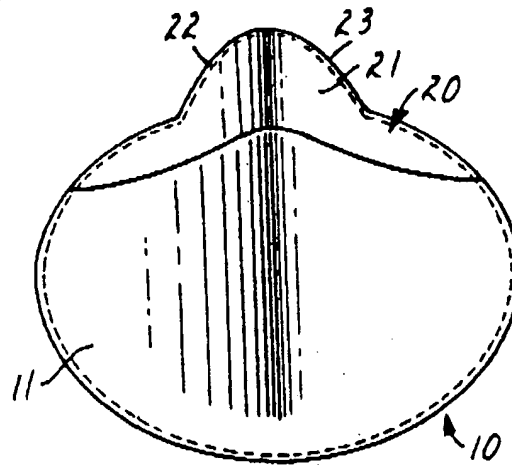
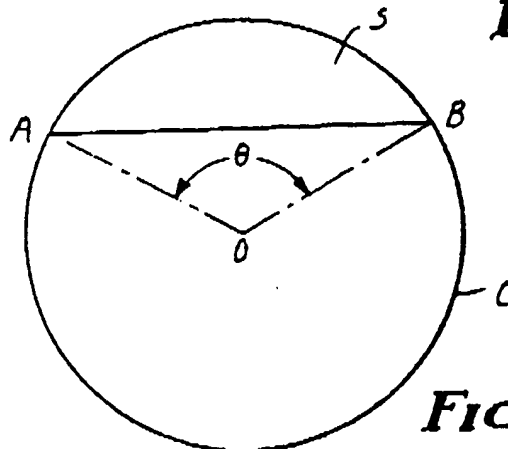
5. The face seal of claim 1 wherein said pad comprises a sheet of a conformable, resilient, closed cell foam material adhered to a sheet of an elastomeric film backing.
6. The face seal of claim 1 wherein said pad comprises a sheet of a conformable, resilient, skinned open cell foam material adhered to a sheet of elastomeric film backing.
7. The face seal of any one of claims 1 to 6 wherein said pad is ultrasonically welded to the perimeter of the respirator body.
8. The face seal of any one of claims 1 to 6 wherein said pad is mechanically attached to the perimeter of the respirator body.
9. The face seal of any one of claims 1 to 6 wherein said pad is adhesively attached to the perimeter of the respirator body.
10. The face seal of claim 2 wherein said conformable, resilient closed cell foam has a thickness between 1/16 and 1/4 inch.
11. The face seal of claim 10 wherein said foam is a polyvinyl chloride foam having a thickness of 1/8 inch.

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**C**

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**FIG. 1****FIG. 2****FIG. 3**

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